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# Skin Graft Fixation and Methods

*Sundaram Ravanasmudram Rajaram and Gauthami Sundar*

## Abstract

Skin graft fixation constitutes the most important element for the success of the reconstruction. The stability of the skin graft over the wound is a determinant factor for its survival. Many techniques have been described in the literature for fixing the skin graft. The most frequent of the techniques is the tie over technique. Staples, fibrin glue are other advancements in the arena of skin graft fixation. The skin graft is covered by a dressing material which keeps it undisturbed and protects the graft from infection. The quest for an ideal dressing material has led to many innovative materials and methods to apply them.

**Keywords:** history of graft fixation, skin graft fixation, tie over dressing, staples, fibrin glue

## 1. Introduction

Skin grafting is one of the most commonly done surgical procedures as a part of reconstructive process. The skin grafts are routinely being used in a variety of situations including traumatic wound reconstruction, oncologic reconstruction, cosmetic problems like scar contraction. Skin graft fixation forms a crucial step in the success of the skin grafting. Various techniques of skin graft fixation have been practiced and they have their own advantages and disadvantages.

However, the basic principles of the skin graft fixation remains constant and when satisfied leads to the success of the procedure. Varying situations demand varying type of the skin graft fixation techniques.

The conventional skin graft fixation technique involves pressure application over the skin graft using a bolus and tie over sutures. The skin graft edges are fixed to the recipient bed meticulously using sutures that would be removed later. Over the years, further advancements in graft fixation techniques have been witnessed like the use of staples replacing the sutures, glue for skin graft adhesion and Negative wound therapy. This chapter elaborates the various skin graft fixation techniques and the dressing materials which aid in skin graft healing.

## 2. History of skin graft fixation techniques

The history of free skin grafting dates back to as early as 600 BC in ancient India where the defects of the ears, nose and lips were treated using free gluteal grafts and skin grafts [1].

Tile maker caste have been known for practicing free skin grafts, harvested from the gluteal region which was prepared by beating with wooden slippers until significant swelling had taken place they also used a secret cement for adhesion of the skin grafts which was called the “ancient Indian method” [2].

The suturing of the skin edges had been carried out by using giant ants, according to Sushrutha Samhitha. The ants were gently allowed to bite across the skin edges to be approximated. As soon as the ant bites well, the body is cut off leaving the head of the ants in place. There are evidences of using thorns to approximate the skin edges too. Similar technique for skin approximation using the ants had been in practice in ancient Egypt also.

It was the 'cisterian monks' in Worcestershire who made a mark in the history for having used needles and sutures to approximate the wound edges. Evidently after this time scale, the modern day suturing started and securing the skin grafts by sutures come into practice [3].

Bergel in 1909 discussed about the hemostatic nature of fibrin. In 1985, Rose, Dresdale et al. [4] described the combination of fresh frozen plasma and bovine thrombin to form fibrin glue. During the 1990s, the fibrin sealant was widely put into use and became FDA approved. The fibrin also showed adhesive properties that were utilized in cases of fistula closure and seroma prevention. Later it was used as a skin graft fixation agent sometimes replacing sutures and staples [5].

Present day scenario sees the use of sutures, staples and fibrin glues for fixation of the skin grafts.

### **3. Fixation of skin grafts**

The recipient bed interface has a thin fibrin bed that holds the skin graft on to it. The fibrin acts as a barrier against infections that can cause graft failure [6]. Bleeding, shearing force, wound infection can all lead to graft loss, thus necessitating proper anchoring and protective dressing.

The skin graft goes through 2 distinct phases of adherence.

Phase 1: it lasts till 72 hours. The adherence is maintained by fibrin layer.

Phase 2: it commences after 72 hours because of the fibrous ingrowth and vascular anastomoses [7].

#### **3.1 Securing the skin grafts**

The skin graft edges are trimmed and the recipient wound edges are undermined to accommodate the skin graft (**Figure 1a–e**). The edges of the skin graft are approximated and secured to the edges of the recipient wound with sutures or staples (**Figure 2a and b**). The staples have the added advantage of consuming less time in securing the skin graft edges. There are several operators who wish to place absorbable sutures thereby negating the burden of suture removal after healing [8].

#### **3.2 Dressing over the skin graft**

Appropriate dressing is placed over the skin graft for better adaptation and graft healing. This also avoids the seroma formation and hematoma formation that can subsequently lead to infection and graft failure.

##### *3.2.1 Tie over dressing/bolster dressing*

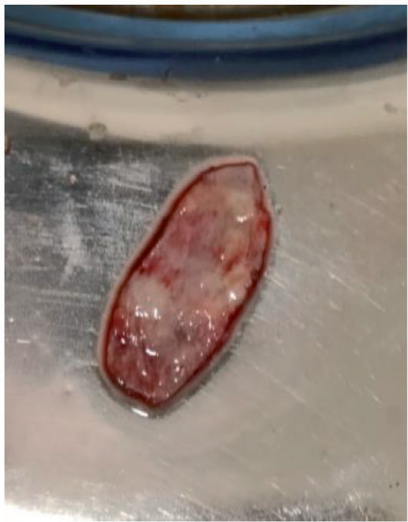
The tie over dressing is one of the earliest and effective methods for graft fixation (**Figure 3a and b**). Once the graft is transferred to the recipient bed and secured with sutures, a bolster is placed on the skin graft and secured with silk sutures running over the bolster and offering some pressure that prevents dislodgement. The bolster generally would be a piled up gauze pieces.



(a)



(b)



(c)



(d)

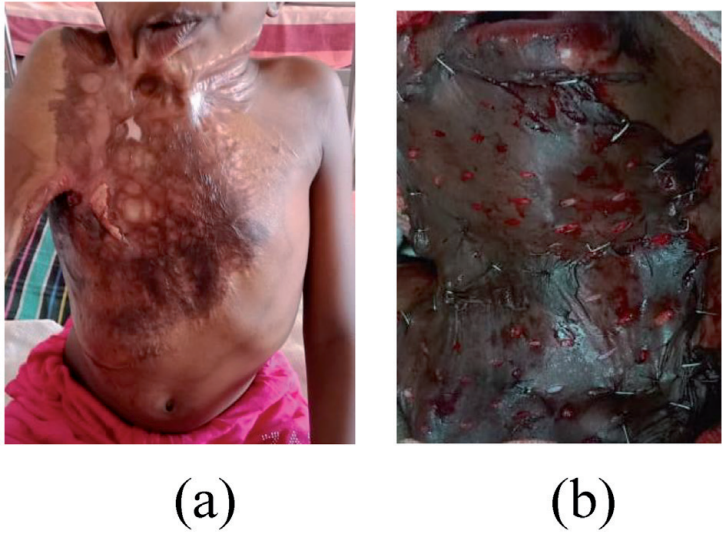


(e)

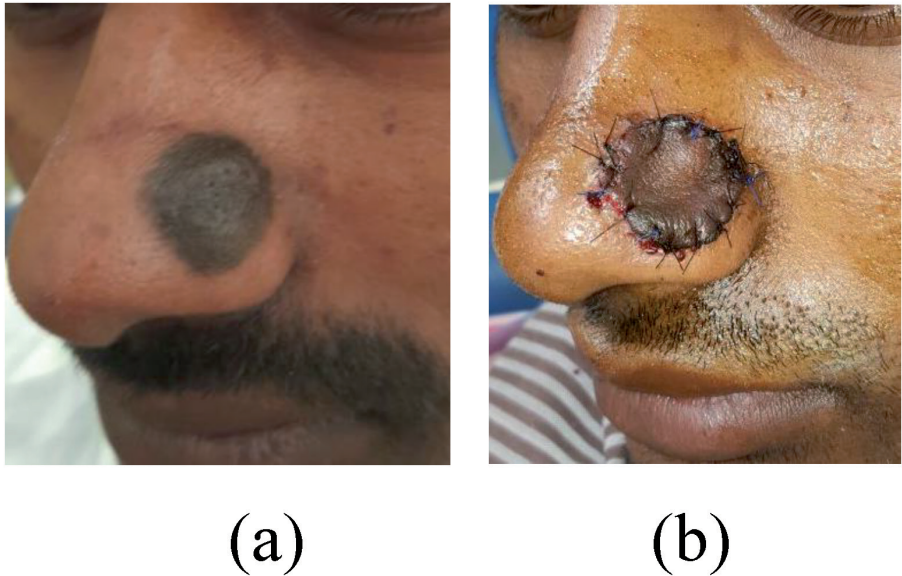
**Figure 1.**  
(a) A case of facial scar. (b) Undermining of wound edges. (c) Skin graft edges trimmed. (d) Skin graft adapted. (e) Skin graft secured with sutures.

Although supported only by some observational studies, the tie over dressing remains simple and effective means for skin graft fixation.





**Figure 2.**  
*(a) A case of burns scar. (b) Skin graft secured with staples.*



**Figure 3.**  
*(a) A case of melanocytic naevus. (b) Initial healing of Skin graft after bolster removal.*

Tie over dressing involves downward pressure on the skin graft surface thereby adapting the skin graft well onto the recipient area thus eliminating the hematoma and seroma formation leading to good take of the skin graft. The principle of tie over dressing remains as simple as that.

Such a simple technique also is accountable for flipside issues inviting criticism. The downward pressure when it exceeds the capillary pressure, can cause graft damage. Prolonged intraoperative time and graft healing time, technique sensitive procedure, may hinder inspection and wound care in the postoperative period are other disadvantages. Also, no Randomized Control trials exist to prove the superiority of tie over technique over non tie over techniques [9].

### *3.2.2 Negative wound therapy*

Negative wound therapy consists of application of gauze packs over the skin graft which is sealed by sticking an adhesive dressing. The dressing consists of

a small fenestration that is connected to the vacuum regulator with the pressure maintained at 125 mm Hg.

Mohsin et al. concluded from their study that negative wound therapy has the following advantages.

- decreases the need for secondary coverage procedures.
- shortens the length of hospital stay.
- Early healing [10].

### 3.2.3 Non pressure dressings

Netscher and associates advocate moist non adherent gauze applied over the grafted site and is secured with self-adhering foam. Application and removal of the dressings are technically easy and it offers an even pressure over the grafted area [11].

Saltz and Bowles also advocate using Reston foam applied over Xenoform gauze as graft dressings [12]. Minami and colleagues acknowledge the usefulness of polyurethane dressings over the skin grafts as such dressings avoid the risks of pressure necrosis that is seen in tie over dressings [13].

Balakrishnan advocates the use of Lyofoam, which is applied over the graft directly. It is an inert, bacteriostatic, semipermeable polyurethane foam that enhances reepithelialization. Its inner surface is smooth and hydrophilic and outer surface is hydrophobic. Lyofoam is directly applied over the skin grafts and secured with staples [14].

### 3.2.4 Fibrin glue/octyl-2-cyanoacrylate (“super glue”)

Fibrin sealant, two component material composed of fibrin and thrombin has been widely used as an adhesive for the skin graft ever since it got FDA approved. When applied at the skin edges it exhibits a remarkable adhesion property [15].

It has been advocated for its property of improving graft survival, reducing blood loss, hastening healing over large surface and thereby produces better results. A thin layer of fibrin glue significantly improves the graft take especially in mobile parts of the body [16].

### 3.2.5 Quilting

Quilting involves placing basing sutures on the surface of the graft thereby adapting it well to the recipient bed. Such quilting sutures are generally placed using absorbable ones. They are aimed at reducing the dead space in the graft that can lead to seroma formation.

In a study conducted by Yuhui Wu, the quilting sutures have been documented to reduce grade 2 and 3 seroma thereby improving the healing [17].

Other dressing materials are listed in the **Table 1**.

### 3.2.6 Tie over dressing vs. non tie over technique

Akhavani et al. and Dhillon et al. compared both these techniques to find out there is no statistically significant difference in graft take rate and infections. Even a study conducted by Yuki et al. in 266 patients also concluded the same [32–34].

S. no	Author	Dressing used
1	Johnson, Flemming and Avery [18]	staples with latex foam
2	Wolf and coworkers [19]	Rubber foam with staples
3	Smoot [20]	Staples and xenoform sandwich filled with cotton
4	Amir et al [21].	Disposable syringes and silk threads
5	Cheng and colleagues [22]	Base of the IV infusion bottle and silk sutures
6	Vloemans and colleagues [23]	silicone rubber dressings
7	Sawada [24]	and silicone gel sheets
8	Renz BM [25]	rubber band stents
9	Ren J [26]	transparent gasbag tie-over dressings
10	Ward RS [27]	Coban self-adherent wrap
11	Grabski WJ [28]	thin hydrocolloid dressing
12	Watson SB [29] Balakrishanan C [30] Wells MD [31]	Assorted Silastic and foam dressings

**Table 1.**  
*Other dressing materials documented.*

In our experience, the application of pressure over the skin graft becomes an optional entity and is sometimes dictated only by the anatomical area to be grafted. Any anatomical area that displays frequent movement that self-endangers the viability of the skin graft needs a Tie over dressing. Also an anatomical area where dead space creates the risk of seroma or hematoma collection compromising the adaptation of skin graft requires a tie over dressing for better adaptation. This again confirms the evidences that draw inconclusive evidences about the best type of skin graft fixation techniques.

In certain cases, absorbable sutures are preferred over the silk sutures as the silk gets buried while the bolster is removed when the healing is complete. Although our experience with cyanoacrylate glue is limited, the idea of applying any material other than autogenous entities had always raised concerns for the fear of it instilling hypersensitivity reactions.

### 3.3 Challenging anatomical areas for skin graft fixation

The advances in the ablative surgical techniques have only left with more complexities for the reconstruction procedures. The necessity and the radical nature of oncologic resections carried out in the head and neck areas demand meticulous reconstructive measures that make them challenging [35].

#### 3.3.1 Reconstruction of the sinus cavities

Post resection, the skin graft is secured with sutures in the sinus lining and available cancellous bone surfaces. The sinus is stuffed with petrolatum gauze that would offer even pressure over the skin graft surface. One of the ends of the gauze is seen jetting out through orifices created intraorally or at the face near the floor of the orbit. After the healing, the gauze is gently removed out through the orifices. The remaining orifice defects are addressed prosthetically.

### *3.3.2 Reconstruction of alveolus*

The alveolar bone is trimmed to make the cancellous bone exposed. The skin graft margins are adapted perfectly over the cancellous bone surface and adjacent soft tissue. Sutures are placed if possible. Acrylic stent dressing is placed over the gauze dressing.

In mandible, the acrylic is secured in situ by circum mandibular wiring. In maxilla, the acrylic stent is secured by peralveolar wiring or lateral suspension wiring.

### *3.3.3 Reconstruction of floor of mouth*

The skin graft adaptation and securing is carried out by help of sutures. The gauze foam dressing that is applied over the graft is secured with suture ties that run to the supra hyoid region where it is anchored.

### *3.3.4 Reconstruction of palate*

Palatal skin graft fixation requires construction of a Hawley's appliance with a palatal extension that would fill in the defect. This acrylic stent is fabricated preoperatively and is applied over the palatal skin graft. (**Figure 4a and b**).

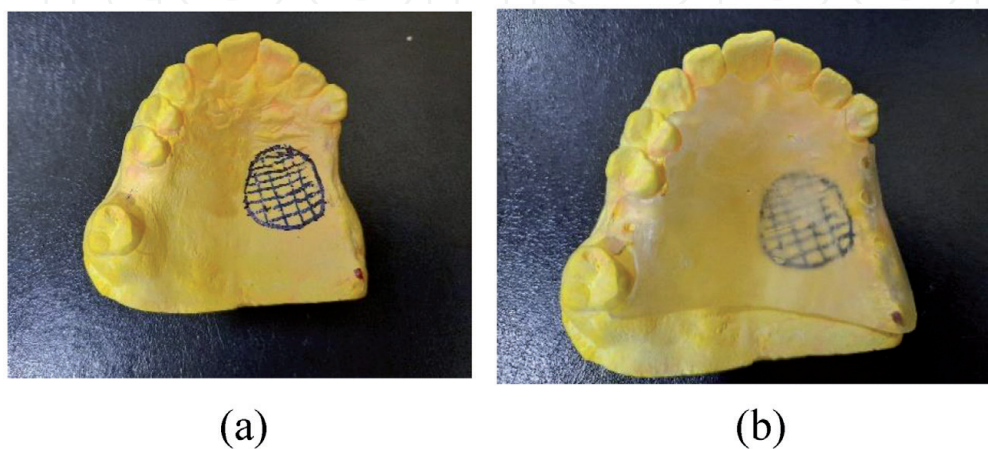
### *3.3.5 Reconstruction of tongue*

The tongue is an extremely mobile organ where the skin graft fixation becomes very difficult. The grafted site is covered with foam dressing. The tongue is then compressed into the floor of the mouth by the fixation of a plate lined with foam-rubber sponge. The plate in turn is anchored to the teeth using wires or with circummandibular wiring if edentulous.

Tongue physiotherapy is carried out post healing to prevent fibrosis.

### *3.3.6 Reconstruction of larynx*

After the appropriate portions of the laryngeal structures have been excised, inclusive of the homolateral laryngeal tissues and frequently passes beyond the anterior commissure or posterior commissure to the opposite cord, the graft is fitted



**Figure 4.**  
(a) Model with diagrammatic presentation of extent of the defect. (b) Acrylic stent.



to the outside of a modeled tantalum wire-mesh or plastic framework and carefully sutured into position. The position is maintained by a stent that avoids stenosis due to contraction.

#### **4. Conclusion**

In conclusion, the skin graft techniques and dressings are few in number for consideration and have their own indications, merits and demerits. Functionally all the fixation techniques when done well and proper serve the healing of the graft well. No technique rules over the other with better benefits. Evidence of comparison of the fixation techniques also prove the same till date. Future is foreseen to develop newer techniques for graft fixation and dressings and more evidence based comparison for arriving at better conclusions.

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#### **Conflict of interest**

The authors declare no conflict of interest.

#### **Notes/thanks/other declarations**

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## Author details

Sundaram Ravanasmudram Rajaram<sup>1\*</sup> and Gauthami Sundar<sup>2</sup>

1 University of Science and Technology, Fujairah, United Arab Emirates

2 Dr.Rajaram's Dental Surgery, Thanjavur, India

\*Address all correspondence to: [sundarum88@gmail.com](mailto:sundarum88@gmail.com)

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